Amendments to the Claims

This listing of claims replaces all prior versions and listings of claims in the application.

Listing of Claims

1-25. (Canceled)

26. (Currently Amended) A method of manufacturing a semiconductor device comprising:

providing a semiconductor film on an insulating surface;

providing said semiconductor film with a catalyst metal-containing material;

crystallizing said semiconductor film by heating in a way that causes said catalyst metal to diffuse through the semiconductor film and function to promote the crystallization of the semiconductor film;

forming a gettering layer comprising phosphorus silicate glass over an entire surface of said semiconductor film after the crystallization; and

heating said semiconductor film and said gettering layer in order to getter the catalyst metal in said semiconductor film using said gettering layer.

27. (Previously Presented) A method according to claim 26 wherein said semiconductor device is a photoelectric conversion device.

28. (Previously Presented) A method according to claim 26 wherein said heating to getter the catalyst metal is continued for 1-4 hours.

29. (Previously Presented) A method according to claim 26 wherein said phosphorus silicate glass contains phosphorus at a concentration of 1 to 30 wt%.

30-31. (Canceled)

32. (Previously Presented) A method according to claim 26 wherein said catalyst metal is selected from the group consisting of Ni, Fe, Co, and Pt.

33. (Previously Presented) A method according to claim 26 further comprising a step of removing said gettering layer after the gettering.

34. (Currently Amended) A method of manufacturing a semiconductor device comprising:

providing a substantially intrinsic semiconductor film on an insulating surface;

providing said semiconductor film with a catalyst metal-containing material;

crystallizing said semiconductor film by heating in a way that causes said catalyst metal to diffuse through the semiconductor film and function to promote the crystallization of said semiconductor film;

forming a gettering layer comprising phosphorus silicate glass over an entire surface of said semiconductor film after the crystallization; and

heating said semiconductor film and said gettering layer in order to getter the catalyst metal in said semiconductor film by said gettering layer.

35. (Previously Presented) A method according to claim 34 wherein said semiconductor device is a photoelectric conversion device.

36. (Previously Presented) A method according to claim 34 wherein said heating to getter the catalyst metal is continued for 1-4 hours.

37. (Previously Presented) A method according to claim 34 wherein said phosphorus silicate glass contains phosphorus at a concentration of 1 to 30 wt%.

38. (Canceled)

39. (Previously Presented) A method according to claim 34 wherein said catalyst metal is selected from the group consisting of Ni, Fe, Co, and Pt.

40. (Previously Presented) A method according to claim 34 further comprising a step of removing said gettering layer after the gettering.

41. (Previously Presented) A method according to claim 34 wherein said heating to getter the catalyst metal is conducted within a temperature from 500°C to 800°C.

42. (Currently Amended) A method of manufacturing a semiconductor device comprising:

providing a semiconductor film on an insulating surface;

providing a catalyst metal-containing material on said semiconductor film;

crystallizing said semiconductor film by heating in a way that causes said catalyst metal to diffuse through the semiconductor film and function to promote the crystallization of said semiconductor film;

forming a gettering layer comprising phosphorus silicate glass over an entire surface of said semiconductor film after the crystallization; and

heating said semiconductor film and said gettering layer in a nitrogen atmosphere in order to getter the catalyst metal contained in said semiconductor film by said gettering layer.

43. (Previously Presented) A method according to claim 42 wherein said semiconductor device is a photoelectric conversion device.

44. (Previously Presented) A method according to claim 42 wherein said heating to getter the catalyst metal is conducted for 1-4 hours.

45. (Previously Presented) A method according to claim 42 wherein said phosphorus silicate glass contains phosphorus at a concentration of 1 to 30 wt%.

46. (Canceled)

47. (Previously Presented) A method according to claim 42 wherein said semiconductor film comprises silicon.

48. (Previously Presented) A method according to claim 42 wherein said catalyst metal is selected from the group consisting of Ni, Fe, Co, and Pt.

49. (Previously Presented) A method according to claim 42 further comprising a step of removing said gettering layer after the gettering.

50. (Previously Presented) A method according to claim 42 wherein said heating to getter the catalyst metal is conducted within a temperature from 500°C to 800°C.

51. (Currently Amended) A method of manufacturing a semiconductor device having a junction, said method comprising:

providing a semiconductor film comprising amorphous silicon on an insulating surface;

providing a catalyst metal-containing material on said semiconductor film;

crystallizing said semiconductor film by heating in a way that causes said metal to diffuse through the semiconductor film and to promote the crystallization thereof;

forming a gettering layer comprising phosphorus silicate glass over an entire surface of said semiconductor film after the crystallization;

heating said semiconductor film and said gettering layer at a temperature from 500°C to 800°C in order to getter the metal included in said semiconductor film by said gettering layer; and

forming a doped semiconductor film on said semiconductor film to form a junction.

52. (Previously Presented) A method according to claim 51 wherein said semiconductor device is a photoelectric conversion device.

53. (Previously Presented) A method according to claim 51 wherein said heating to getter the metal is conducted for 1-4 hours.

54. (Previously Presented) A method according to claim 51 wherein said phosphorus silicate glass contains phosphorus at a concentration of 1 to 30 wt%.

55-56. (Canceled)

57. (Previously Presented) A method according to claim 51 wherein said catalyst metal is selected from the group consisting of Ni, Fe, Co, and Pt.

58. (Previously Presented) A method according to claim 51 further comprising a step of removing said gettering layer after the gettering.

59. (Currently Amended) A method of manufacturing a semiconductor device having a junction, said method comprising:

providing a substantially intrinsic semiconductor film on an insulating surface;

providing a catalyst metal on said semiconductor film;

crystallizing said semiconductor film by heating to cause said catalyst metal to diffuse through the semiconductor film and to promote the crystallization of said semiconductor film;

forming a gettering layer comprising phosphorus silicate glass over an entire surface of said semiconductor film after the crystallization thereof;

heating said semiconductor film and said gettering layer in order to getter the catalyst metal in said semiconductor film by said gettering layer; and

forming a junction using said intrinsic semiconductor film.

60. (Previously Presented) A method according to claim 59 wherein said semiconductor device is a photoelectric conversion device.

61. (Previously Presented) A method according to claim 59 wherein said heating to getter the catalyst metal is continued for 1-4 hours.

62. (Previously Presented) A method according to claim 59 wherein said phosphorus silicate glass contains phosphorus at a concentration of 1 to 30 wt%.

63. (Canceled)

64. (Previously Presented) A method according to claim 59 wherein said catalyst metal is selected from the group consisting of Ni, Fe, Co, and Pt.

65. (Previously Presented) A method according to claim 59 further comprising a step of removing said gettering layer after the gettering.

66. (Previously Presented) A method according to claim 59 wherein said heating to getter

the catalyst metal is conducted within a temperature from 500°C to 800°C.

67. (Currently Amended) A method of manufacturing a semiconductor device having a junction, said method comprising:

providing a semiconductor film comprising amorphous silicon formed on an insulating surface;

providing a catalyst metal-containing material on said semiconductor film;

crystallizing said semiconductor film by heating in a way that causes said catalyst metal to diffuse through the semiconductor film and function to promote the crystallization of said semiconductor film;

forming a gettering layer comprising phosphorus silicate glass over an entire surface of said semiconductor film after the crystallization; and

heating said semiconductor film and said gettering layer in a nitrogen atmosphere in order to getter the catalyst metal contained in said semiconductor film by said gettering layer; and

forming a junction on said semiconductor film.

68. (Previously Presented) A method according to claim 67 wherein said semiconductor device is a photoelectric conversion device.

69. (Previously Presented) A method according to claim 67 wherein said heating to getter the catalyst metal is continued for 1-4 hours.

70. (Previously Presented) A method according to claim 67 wherein said phosphorus silicate glass contains phosphorus at a concentration of 1 to 30 wt%.

71-72. (Canceled)

73. (Previously Presented) A method according to claim 67 wherein said catalyst metal is selected form the group consisting of Ni, Fe, Co, and Pt.

74. (Previously Presented) A method according to claim 67 further comprising a step of removing said gettering layer after the gettering.

75. (Previously Presented) A method according to claim 67 wherein said heating to getter the catalyst metal is conducted within a temperature from 500°C to 800°C.

76. (Currently Amended) A method of manufacturing a semiconductor device, comprising:

providing a semiconductor film on an insulating surface;

forming a catalyst metal-containing material on said semiconductor film, said catalyst being a material which facilitates crystallization of said semiconductor film, but which when present in a final product of the semiconductor device degrades operation of the semiconductor device;

crystallizing said semiconductor film by heating in a way that causes said catalyst metal-containing material to diffuse into at least a part of the semiconductor film, said catalyst metal-containing material when so diffused functioning to facilitate said crystallization;

forming a gettering layer comprising phosphorus silicate glass over an entire surface of said semiconductor film after said crystallization; and

processing said semiconductor film and said gettering layer to remove at least one portion of said catalyst metal in said semiconductor film.

77. (Canceled)

78. (Previously Presented) A method as in claim 76, wherein said metal includes Nickel.

79. (Previously Presented) A method as in claim 76, wherein said catalyst material allows said crystallization to occur at a lower temperature.

80. (Canceled)

81. (Currently Amended) A method of manufacturing a semiconductor device comprising:

providing a semiconductor film on an insulating surface;

providing said semiconductor film with a metal-containing material;

crystallizing said semiconductor film by heating in a way that causes said metal to diffuse through the semiconductor film and function to promote the crystallization of the semiconductor film;

introducing a gettering material into a surface of said crystallized semiconductor film within a region of 0.1 to 0.2 μm in depth from the surface of the crystallized semiconductor film;

heating said semiconductor film after introducing said gettering material in order to getter the metal in said semiconductor film; and

removing at least said ~~entire~~ surface after gettering the metal in said semiconductor film.

82. (Currently Amended) A method of manufacturing a semiconductor device comprising:

providing a semiconductor film doped with boron at a concentration of 0.001-0.1 atm %

on an insulating surface;

providing said semiconductor film with a metal-containing material;

crystallizing said semiconductor film by heating in a way that causes said metal to diffuse through the semiconductor film and function to promote the crystallization of said semiconductor film;

forming a gettering layer comprising phosphorus silicate glass over an entire surface of said semiconductor film after the crystallization; and

heating said semiconductor film and said gettering layer in order to getter the metal in said semiconductor film by said gettering layer.

83. (Currently Amended) A method of manufacturing a semiconductor device comprising:

providing a substantially intrinsic semiconductor film on an insulating surface;

providing said semiconductor film with a metal-containing material;

crystallizing said semiconductor film by heating in a way that causes said metal to diffuse through the semiconductor film and function to promote the crystallization of said semiconductor film;

introducing a gettering material into a surface of the crystallized semiconductor film within a region of 0.1 to 0.2 μm in depth from the surface of the crystallized semiconductor film;

heating said semiconductor film after introducing said gettering material in order to getter the metal in said semiconductor film; and

removing at least said ~~entire~~ surface after gettering the metal in said semiconductor film.

84. (Currently Amended) A method of manufacturing a semiconductor device comprising:

providing a semiconductor film doped with boron at a concentration of 0.001-0.1 atm % on an insulating surface;

providing said semiconductor film with a metal-containing material;

crystallizing said semiconductor film by heating in a way that causes said metal to diffuse through the semiconductor film and function to promote the crystallization of said semiconductor film;

introducing a gettering material into a surface of the crystallized semiconductor film within a region of 0.1 to 0.2 μm in depth from the surface of the crystallized semiconductor film;

heating said semiconductor film after introducing said gettering material in order to getter the metal in said semiconductor film; and

removing at least said ~~entire~~ surface after gettering the metal in said semiconductor film.

85. (Currently Amended) A method of manufacturing a semiconductor device comprising:

providing a semiconductor film on an insulating surface;

providing a metal-containing material on said semiconductor film;

crystallizing said semiconductor film by heating in a way that causes said metal to diffuse through the semiconductor film and function to promote the crystallization of said semiconductor film;

introducing a gettering material into a surface of the crystallized semiconductor film within a region of 0.1 to 0.2 μm in depth from the surface of the crystallized semiconductor film;

heating said semiconductor film in a nitrogen atmosphere after introducing said gettering material in order to getter the metal contained in said semiconductor film; and

removing at least said ~~entire~~ surface after gettering the metal in said semiconductor film.

86. (Currently Amended) A method of manufacturing a semiconductor device having a junction, said method comprising:

providing a semiconductor film doped with boron at a concentration of 0.001-0.1 atm % on an insulating surface;

providing a metal on said semiconductor film;

crystallizing said semiconductor film by heating to cause said metal to diffuse through the semiconductor film and to promote the crystallization of said semiconductor film;

forming a gettering layer comprising phosphorus silicate glass over an entire surface of said semiconductor film after the crystallization thereof;

heating said semiconductor film and said gettering layer in order to getter the metal in said semiconductor film by said gettering layer; and

forming a junction using an intrinsic semiconductor film.

87. (Currently Amended) A method of manufacturing a semiconductor device having a junction, said method comprising:

providing a substantially intrinsic semiconductor film on an insulating surface;

providing a metal on said semiconductor film;

crystallizing said semiconductor film by heating to cause said metal to diffuse through the semiconductor film and to promote the crystallization of said semiconductor film;

introducing a gettering material into a surface of the crystallized semiconductor film within a region of 0.1 to 0.2 μm in depth from the surface of the crystallized semiconductor film;

heating said semiconductor film after introducing said gettering material in order to getter the metal in said semiconductor film by said phosphorus;

removing at least said ~~entire~~ surface after gettering the metal in said semiconductor film; and

forming a junction using a doped semiconductor film.

88. (Currently Amended) A method of manufacturing a semiconductor device having a junction, said method comprising:

providing a semiconductor film doped with boron at a concentration of 0.001-0.1 atm % on an insulating surface;

providing a metal on said semiconductor film;

crystallizing said semiconductor film by heating to cause said metal to diffuse through the semiconductor film and to promote the crystallization of said semiconductor film;

introducing a gettering material into a surface of the crystallized semiconductor film within a region of 0.1 to 0.2 μm in depth from the surface of the crystallized semiconductor film;

heating said semiconductor film and said gettering material in order to getter the metal in said semiconductor film;

removing at least said ~~entire~~ surface after gettering the metal in said semiconductor film; and

forming a junction using an intrinsic semiconductor film.

89. (Currently Amended) A method of manufacturing a semiconductor device comprising:

providing a semiconductor film on an insulating surface;

forming a metal-containing material on said semiconductor film, said metal being a material which facilitates crystallization of said semiconductor film, but which when present in a

final product of the semiconductor device degrades operation of the semiconductor device;

crystallizing said semiconductor film by heating in a way that causes said metal-containing material to diffuse into at least a part of the semiconductor film, said metal-containing material when so diffused functioning to facilitate said crystallization;

introducing a gettering material into a surface of the crystallized semiconductor film within a region of 0.1 to 0.2 μm in depth from the surface of the crystallized semiconductor film;

processing said semiconductor film after introducing said gettering material to remove at least one portion of said metal in said semiconductor film; and

removing at least said ~~entire~~ surface of the crystallized semiconductor film after gettering the metal in said semiconductor film.

90. (Previously Presented) A method according to any one of claims 26, 34, 42, 51, 59, 67, 76 or 81-89 wherein said insulating surface comprises silicon oxide.

91. (Previously Presented) A method according to any one of claims 26, 34, 42, 51, 59, 67, 76 or 81-89 wherein the concentration of said metal in said crystallized semiconductor film is not higher than $5 \times 10^{18}$ atoms/cm$^3$.

92. (Canceled)

93. (Previously Presented) A method according to any one of claims 26, 34, 42, 51, 59, 67, 76 81, 85, or 89 wherein said semiconductor film is provided by a plasma CVD technique.

94. (Previously Presented) A method according to any one of claims 26, 34, 42, 51, 59, 67, 76 81, 85, or 89 wherein said semiconductor film is provided by a low pressure CVD technique.

95. (Previously Presented) A method according to any one of claims 26, 34, 42, 51, 59,

67, 76 81, 85, or 89 wherein said semiconductor film is provided by a sputtering technique.

96. (Previously Presented) A method according to any one of claims 82-89 wherein said heating or processing to getter the metal is conducted within a temperature from 500°C to 800°C.

97. (Previously Presented) A method according to any one of claims 81-89 wherein said semiconductor device is a photoelectric conversion device.

98. (Previously Presented) A method according to any one of claims 81-89 wherein said heating or processing to getter the metal is conducted for 1-4 hours.

99. (Previously Presented) A method according to any one of claims 81-89 wherein said metal is selected from the group consisting of Ni, Fe, Co, and Pt.

100-102. (Canceled)

103. (Previously Presented) A method according to any one of claims 26, 34, 42, 51, 59, 67, 76, 82, or 86 wherein said gettering layer is formed by a CVD technique.

104. (Previously Presented) A method according to any one of claims 81, 83-85, or 87-89, wherein said gettering material comprises phosphorus.

105. (Previously Presented) A method according to any one of claims 81, 83-85, or 87-89, wherein said gettering material is introduced by a plasma doping method.

106. (Previously Presented) A method according to any one of claims 26, 34, 42, 51, 59, 67, 76, 82, or 86, wherein said gettering layer is in contact with said semiconductor film.

107. (Previously Presented) A method according to any one of claims 81, 83-85, or 87-89, wherein said gettering material is introduced into an entire surface of the crystallized semiconductor film.